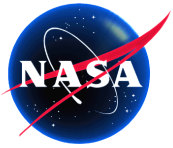


Interferometry in Action

*A Key Technology for NASA's
ORIGINS Program*

Gary H. Blackwood
Jet Propulsion Laboratory
Pasadena, CA



Imagine Yourself Living in 1903

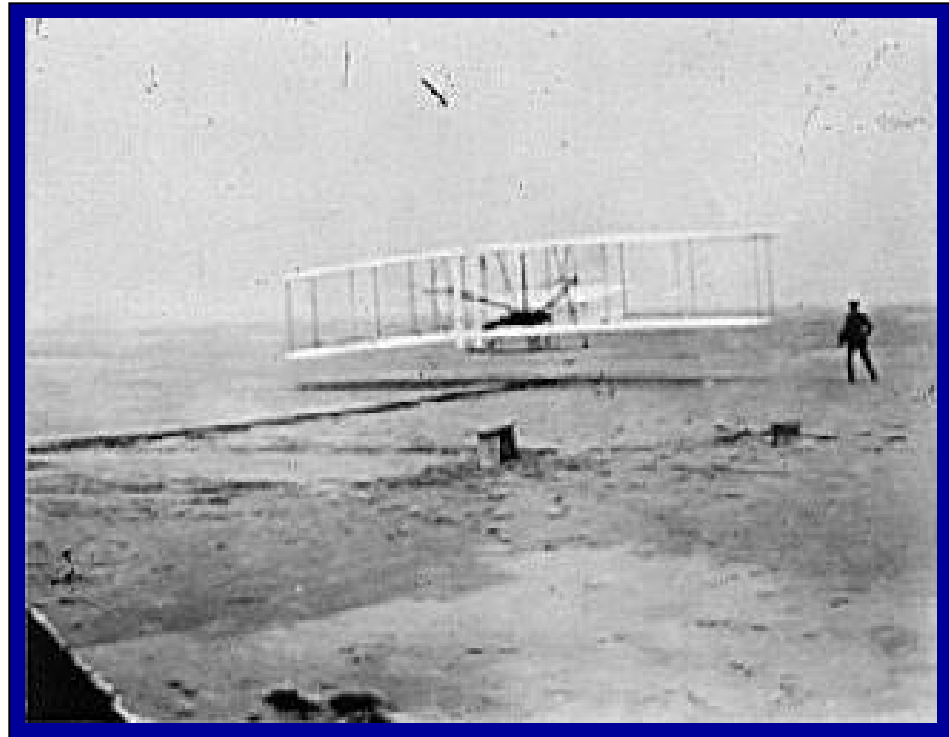


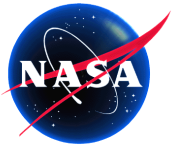
Could you have imagined the world today?

Orville Wright

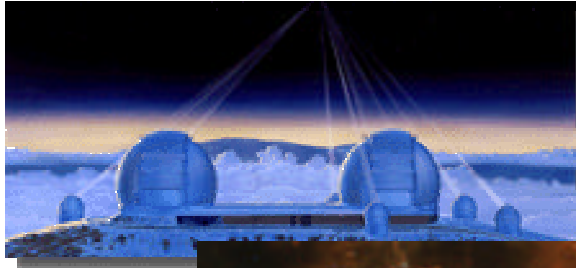


Kitty Hawk, first flight

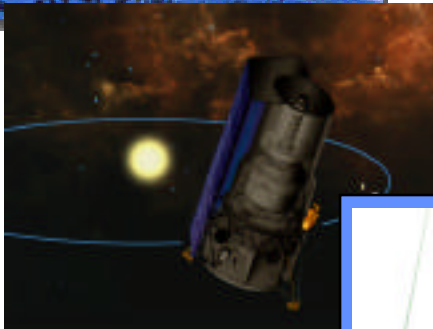




ORIGINS Missions

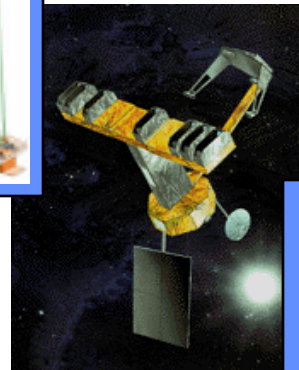
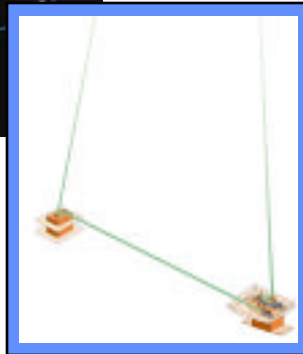


Keck Interferometer
2002



Space Infrared Telescope Facility
2001

ST3
2003

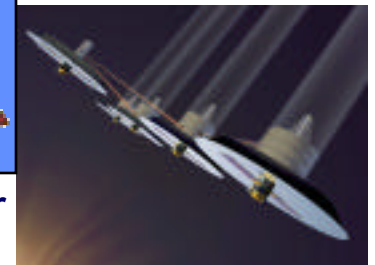


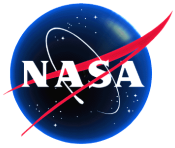
SIM
2005



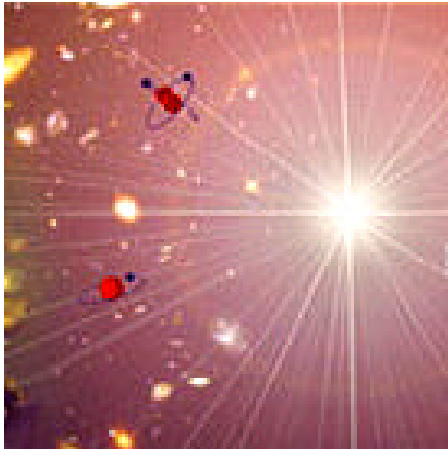
Terrestrial Planet Finder
2011

Next Generation
Space Telescope
2008



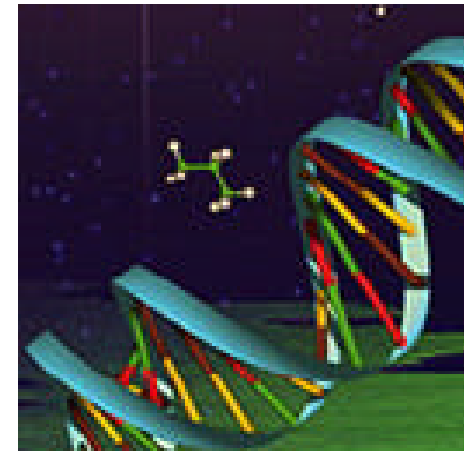


NASA's Big Questions



Where did we come from?

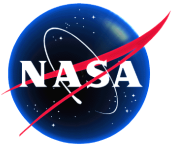
How did we get here?



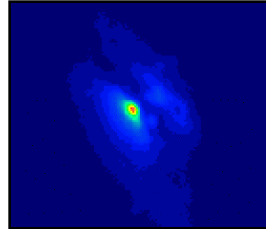
Where are we going?

Are we alone?





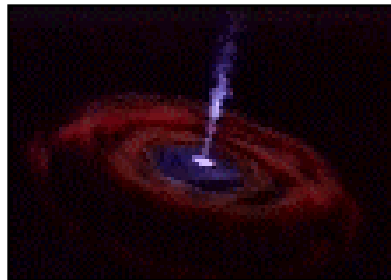
Optical Interferometer Science



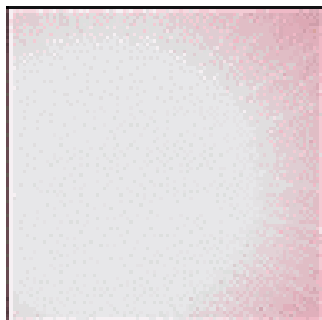
Study of compact astrophysical targets ($>100\times$ resolution of HST)



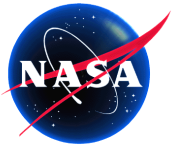
Imaging of stars and their surroundings: X-ray binaries, stars with outflow



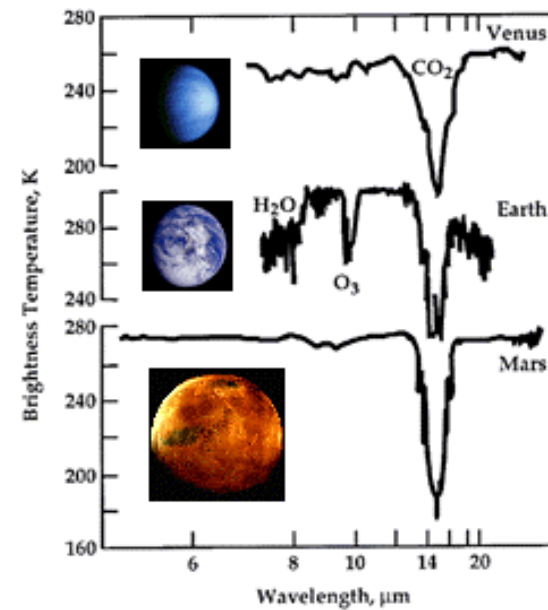
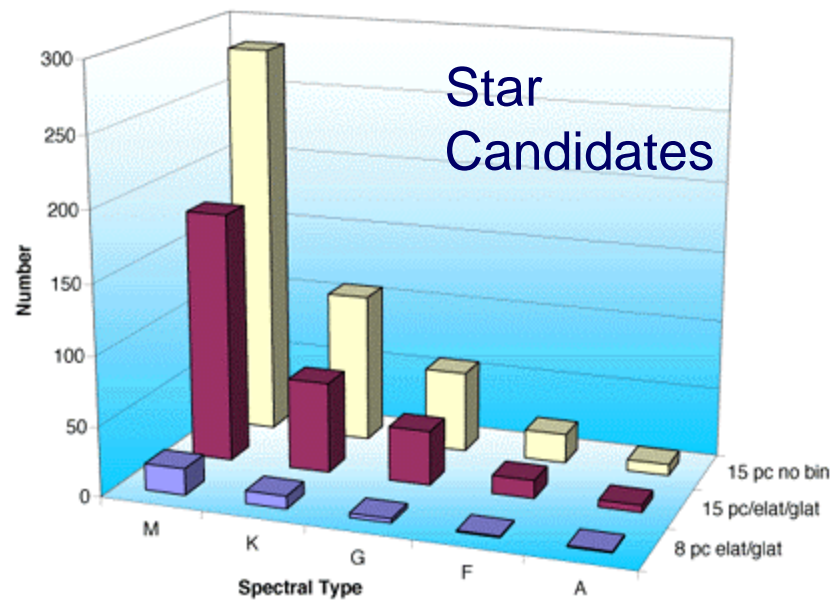
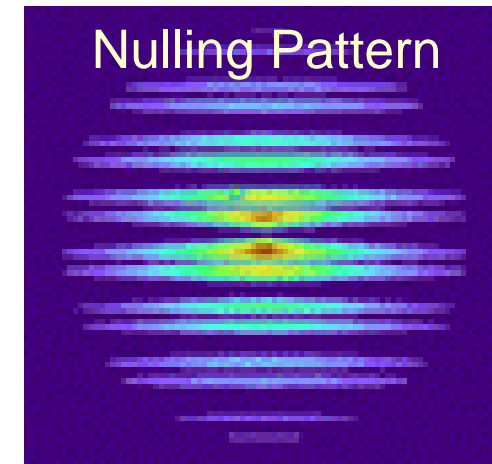
Imaging of Black hole accretion disks



Imaging and spectroscopy of extra-solar planets



Hunting for Earth-like Planets

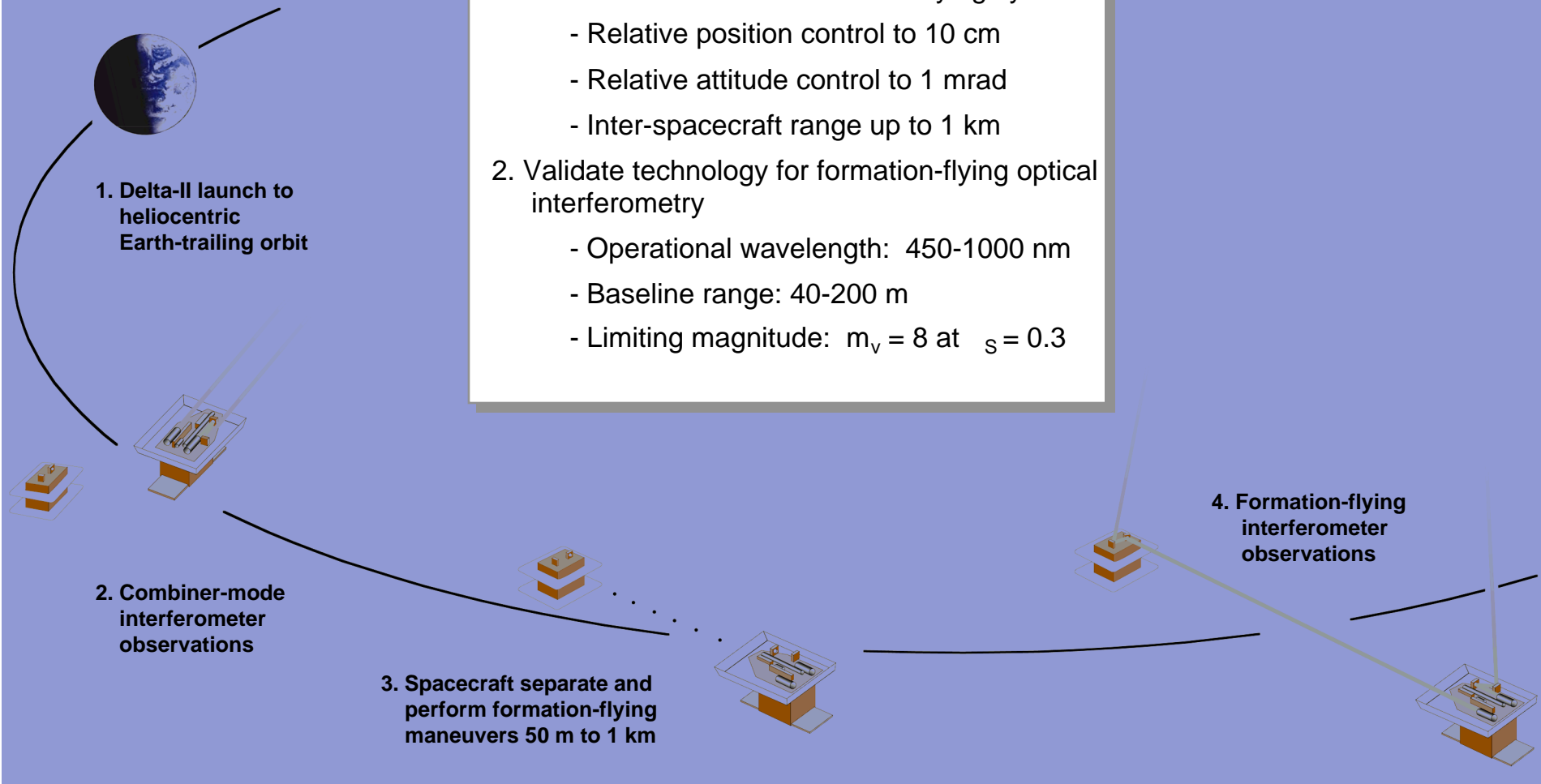


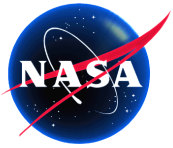
Space Technology 3



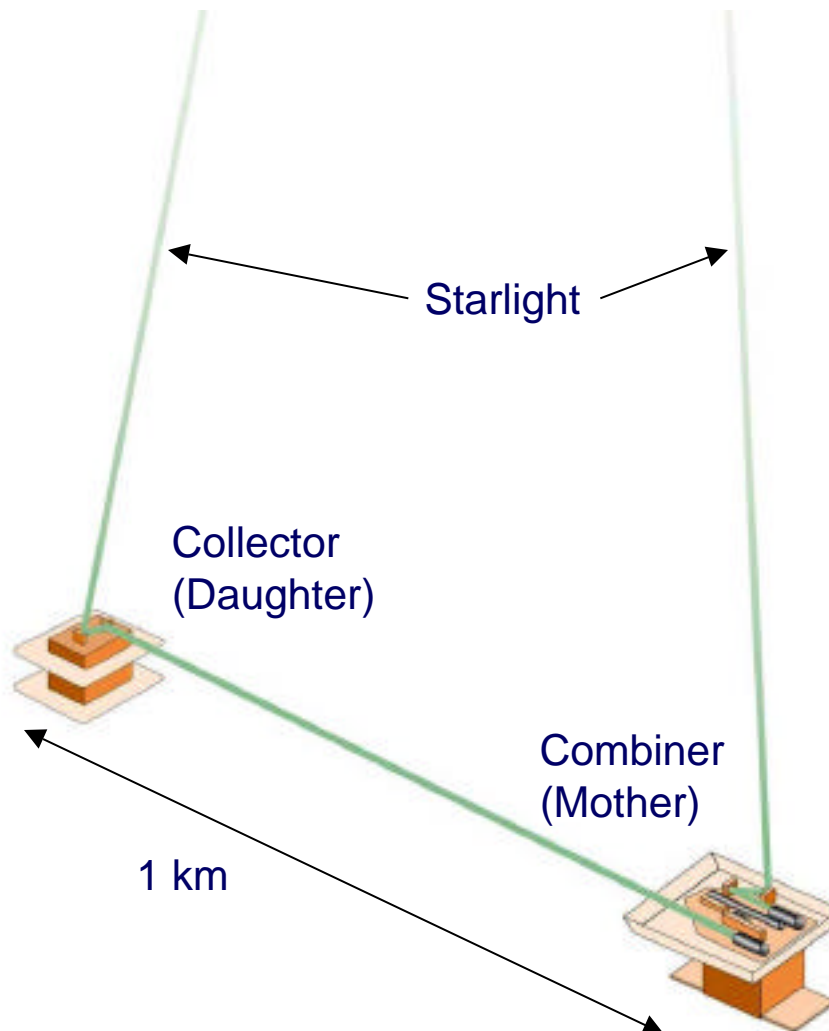
Mission Description:

1. Validate autonomous formation-flying system
 - Relative position control to 10 cm
 - Relative attitude control to 1 mrad
 - Inter-spacecraft range up to 1 km
2. Validate technology for formation-flying optical interferometry
 - Operational wavelength: 450-1000 nm
 - Baseline range: 40-200 m
 - Limiting magnitude: $m_v = 8$ at $s = 0.3$



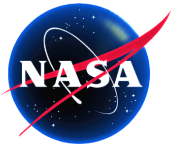


ST3: the “Left Handed Interferometer”

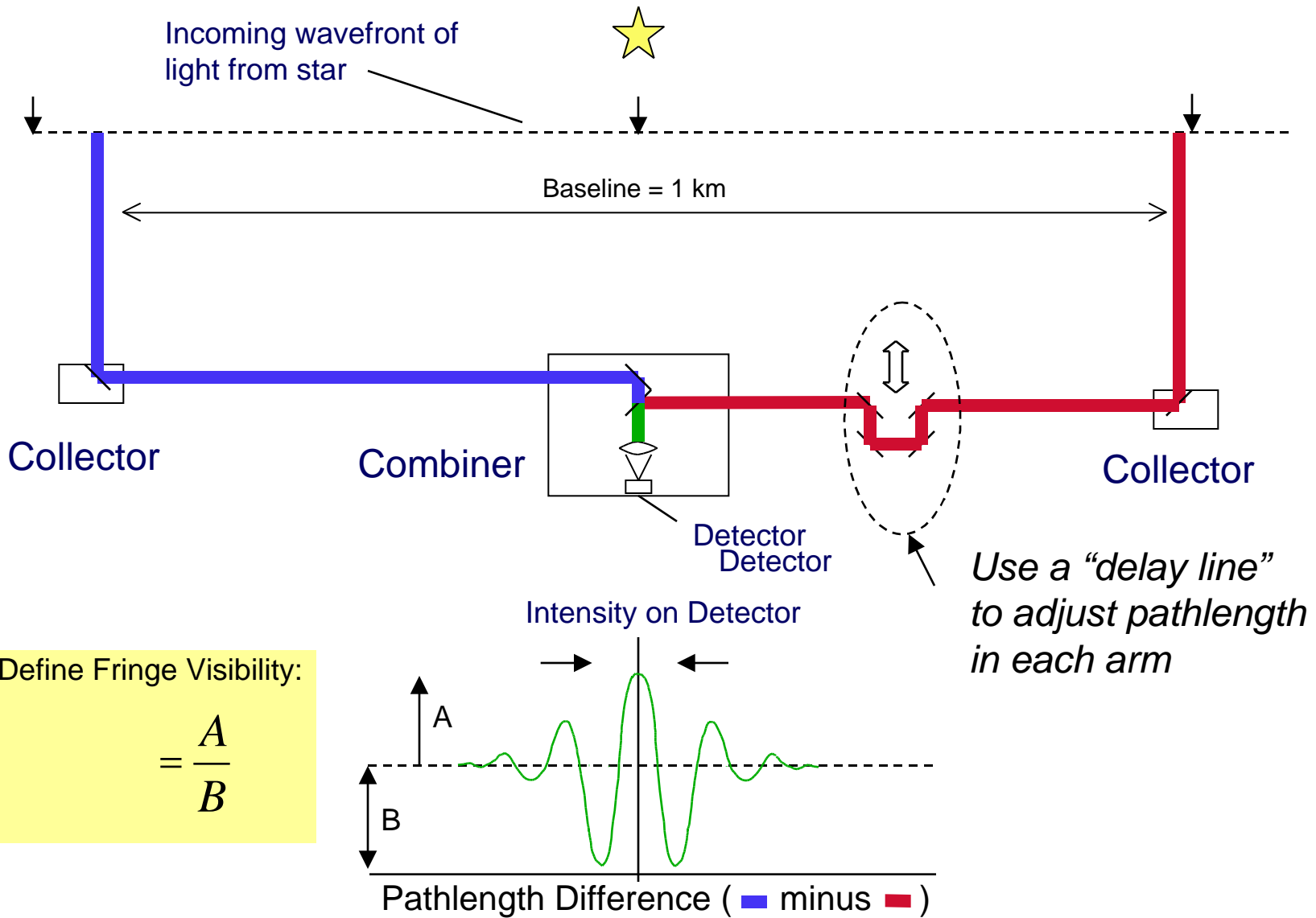


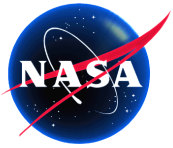
- Formation-flying spacecraft over 1 km
- Laser metrology between spacecraft
- Active optics steer starlight
- High speed active control
- Detector plane: CCD, APD

Why does this interferometer only have one arm?



Interferometry 101: Equal pathlengths for Fringe Detection

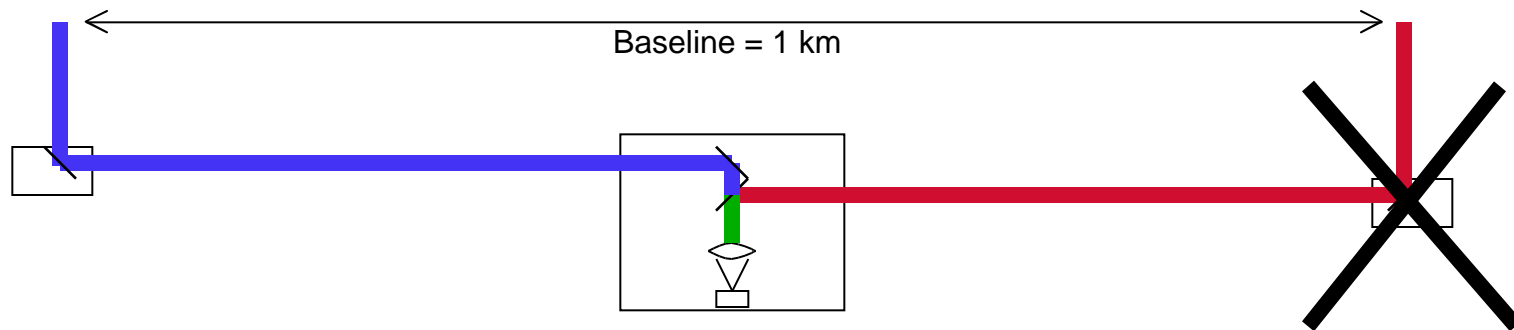




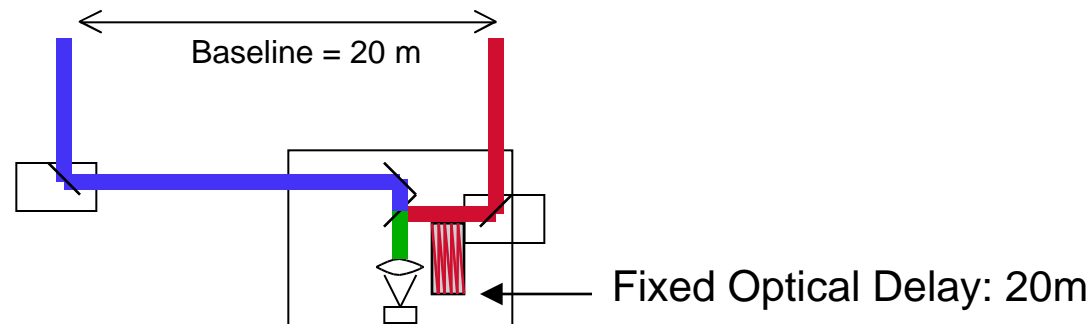
What if we only have 2 spacecraft?



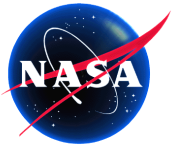
The original 3-spacecraft idea:



**A 2-spacecraft version
had problems:**



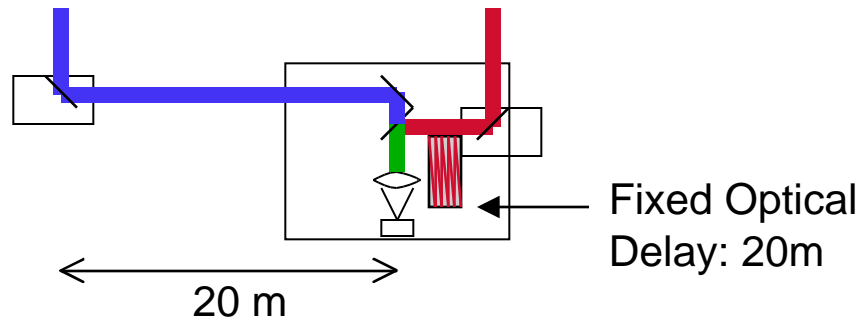
*Problems -- Baseline is only ~20m!
Baseline not adjustable!*



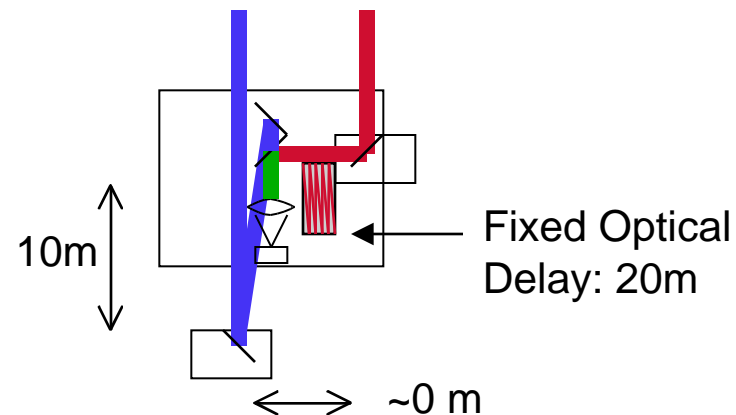
Geometrical Curiosities

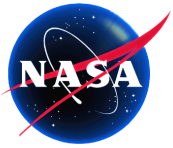


If this geometry works...



Then so does this...

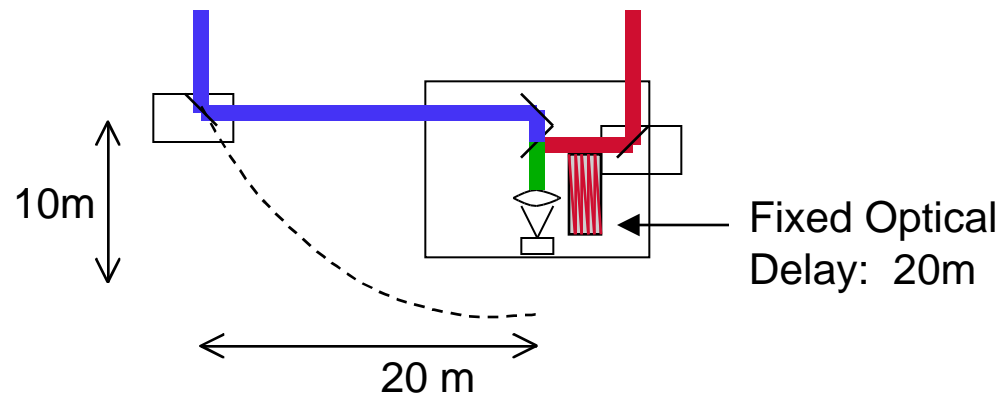




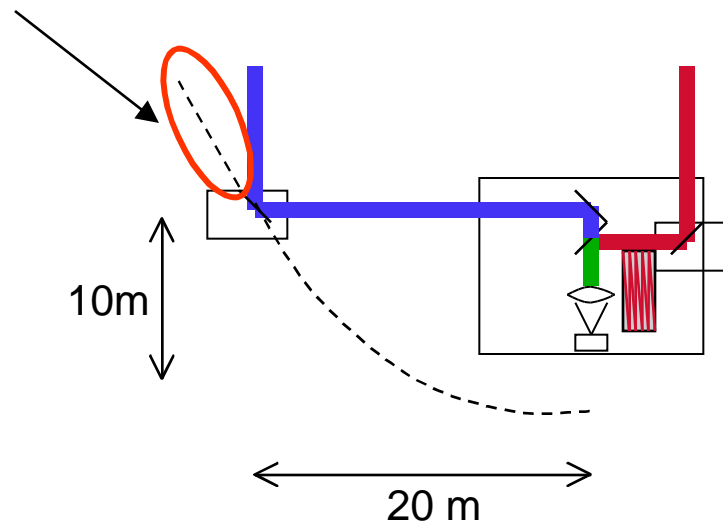
More Curiosities

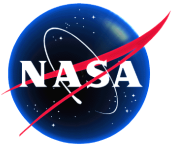


Baseline is variable between 0 and 20 m:

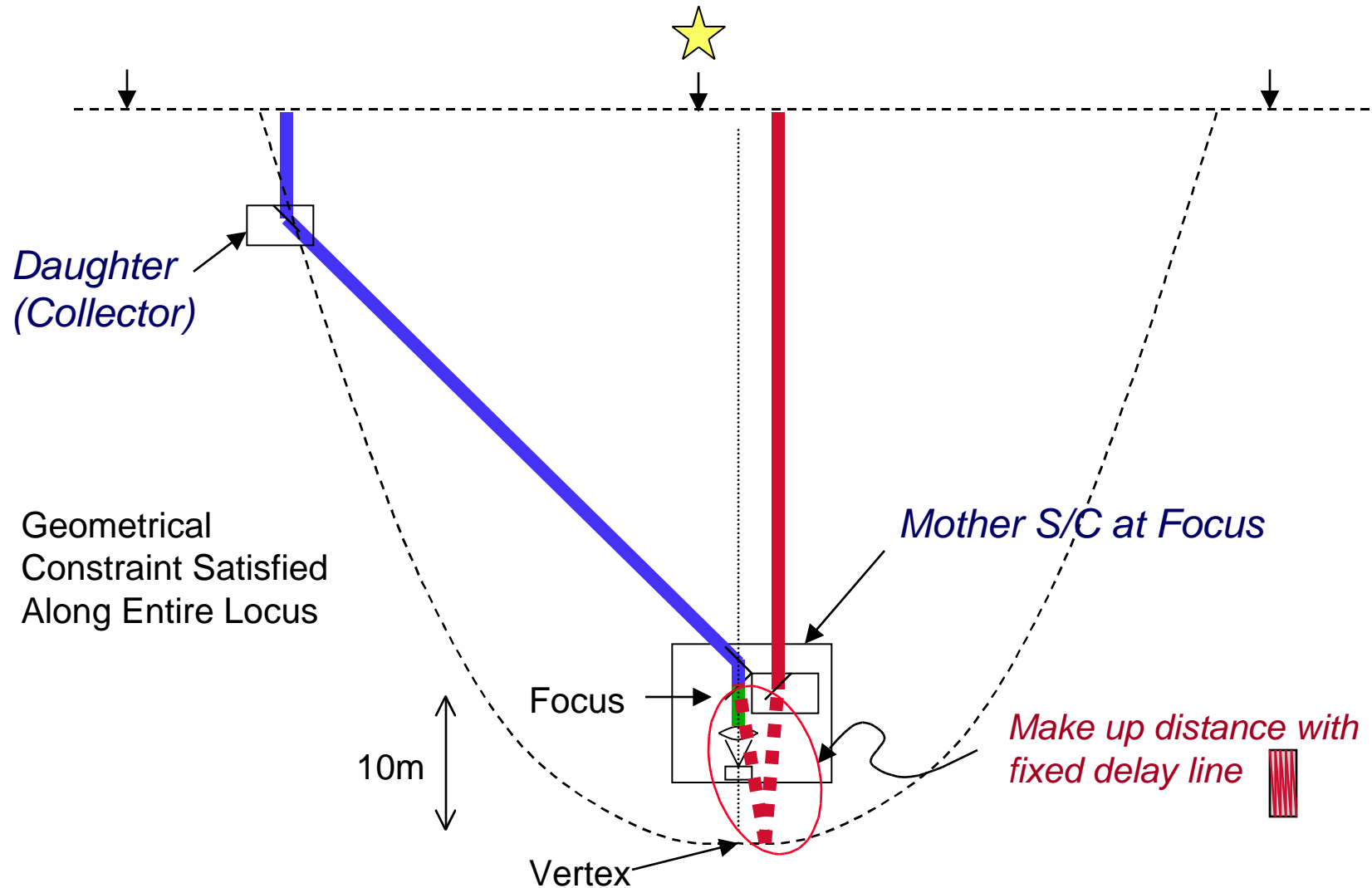


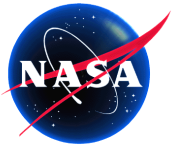
But wait -- there are points out here that work, too!:



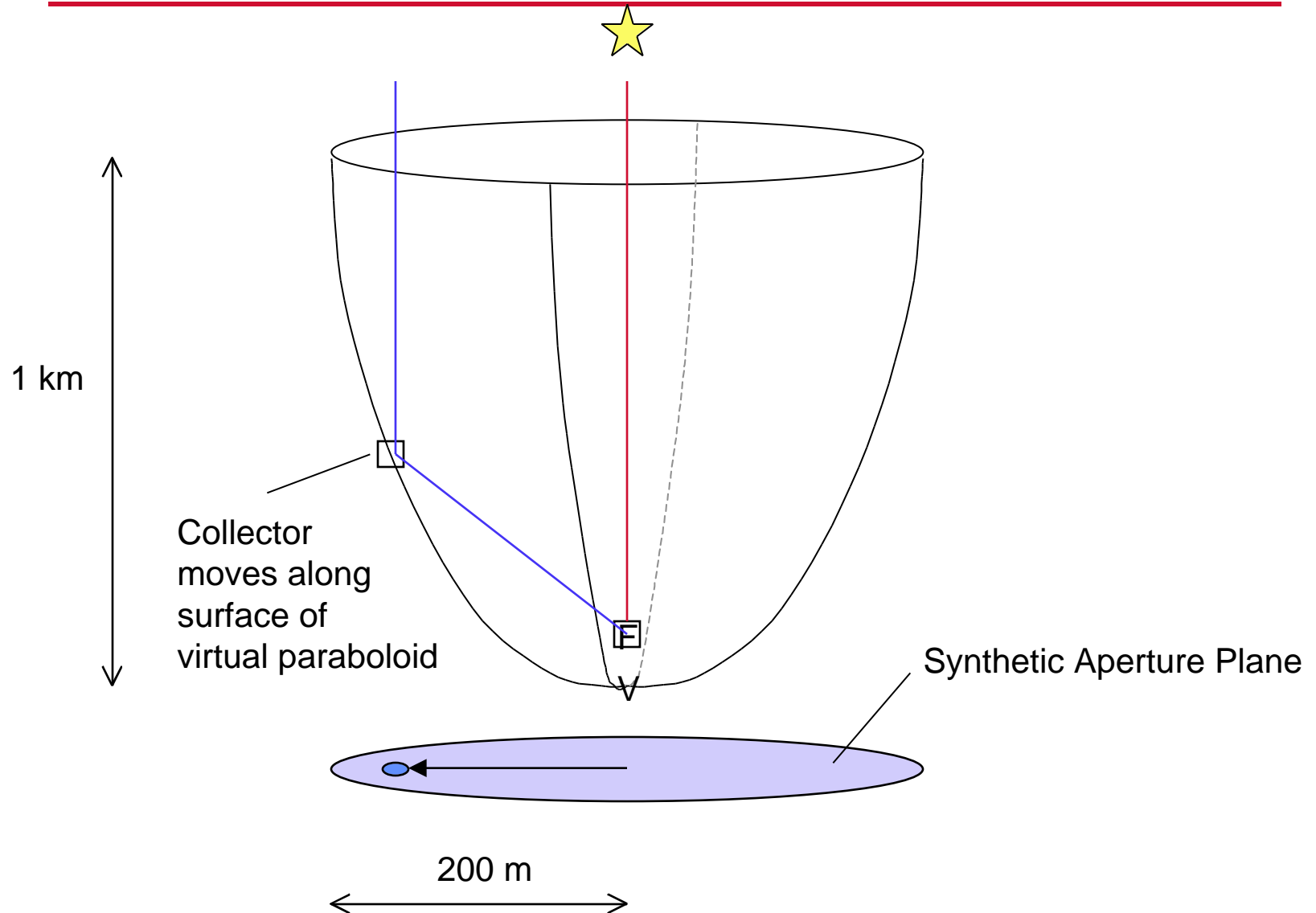


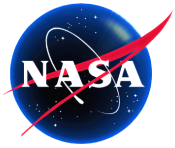
The Breakthrough: a Virtual Parabola !





Aperture Plane Filling





Possible Science with ST3



Phi Persei

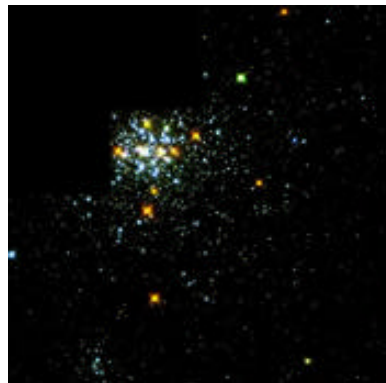


Be Stars -- hot stars surrounded by large disks of gas

Wolf-Rayet star at center of nebula NGC 2359



Wolf-Rayet Stars -- stars with heavy outflows of gas



Measure angular size of M-dwarf stars and improve models of stellar formation

What Future Can You Imagine?

